



Memorandum

U.S. Department
of Transportation

National Highway
Traffic Safety
Administration

DEPT OF TRANSPORTATION

01 JAN -9 AM 8:36

Subject: Submittal of Meeting Minutes of the NHTSA R&D
Event Data Recorder (EDR) Working Group to Docket
No. NHTSA-99-5218 - 7

Date: DEC 22 2000

From: Raymond P. Owings, Ph.D.
Associate Administrator for
Research and Development

Reply to
Attn. of: NRD-01

To: The Docket

THRU: Frank Seales, Jr.
Chief Counsel

Attached are the FINAL and Approved meeting minutes of the NHTSA Research and Development Event Data Recorder (EDR) Working Group meeting held on June 7, 2000.

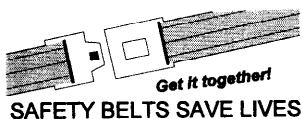
Related meeting history:

Meeting #	Sponsor	DATE
1	MVSRAC	October 2, 1998
2	MVSRAC	February 17, 1999
3	MVSRAC	June 9, 1999
4	MVSRAC	October 6, 1999
5	NHTSA R&D	February 2, 2000
6	NHTSA R&D	June 7, 2000

Research and Development requests that the minutes of this meeting be placed in the public docket.

Attachments

#



NHTSA Research and Development
Event Data Recorder Working Group
Meeting #6

FINAL Minutes
Wednesday, June 7, 2000
9:30 AM - 4:00 PM
NHTSA Headquarters
Washington, DC

The Event Data Recorder (EDR) Working Group held its sixth meeting on June 7, 2000, at NHTSA headquarters in Washington, DC. The main purpose of the meeting was to hold four breakout sessions related to the following objectives of the working group:

How should the data be collected & stored? (Objective #3)

How should the data be retrieved? (Objective #4)

Who should be responsible for keeping the permanent record? (Objective #5)

Demonstration of EDR technology. (Objective #8)

1.0 Welcome, Introduction, and Approval of Previous Meeting Minutes

The meeting was chaired by John Hinch. The agenda for the meeting is included as **Attachment 1**. A list of the meeting attendees is found in **Attachment 2**. The meeting was called to order by John Hinch, who welcomed everyone to the meeting, including a round of self-introductions.

The minutes from the February, 2000, meeting were approved, with minor typographical corrections and inclusion of some new words in the customers' section. The minutes from the October, 1999, meeting were edited prior to placing them in the public docket. These edits included expanding the introduction materials in the minutes associated with the privacy breakout session. Both sets of minutes and attachments will be placed in the Document Management System (DMS), under NHTSA 1999 docket number 5218. You can review this information using the DMS at <http://dms.dot.gov/>.

2.0 Presentations

There were several presentations made to the working group.

2.1 Speed Study

Jennifer Ogle, Georgia Tech, discussed a project where they will be collecting vehicle crash information, using EDRs as part of a larger study, where they are monitoring vehicle speed and location profiles. A copy of her slides can be found at:

<http://rail.cad.gatech.edu/a5011/nhtsakickoff.htm>

A copy of the slides are attached to these minutes as **Attachment 3**.

2.2 Florida Driving Study

Andy Mackevicns, Loss Management Services, Inc. (LMS), presented a discussion of a similar study which was being planned in southern Florida, in conjunction with Florida Atlantic University (FAU) and Forensic Accident Investigation, Inc. Robert McElroy of Forensic

Accident Investigation, Inc., Mary Russell of FAU, and Susan Walker of FAU, also made short presentations. A copy of the LMS slides are found in **Attachment 4**. Susan Walker presented the legal framework for the implementation of EDR technology. A copy of her slides are found in **Attachment 5**.

2.3 Advanced Restraint Investigation

Joe Marsh, Ford Motor Company, made a short presentation related to Ford's participation in NHTSA's special crash investigation program, studying advanced occupant restraint systems. A copy of his presentation is found in **Attachment 6**.

2.4 Data Element Summary

Between the February and June meeting, Kathy Gravino, DaimlerChrysler, worked with other OEMs to put together a list of the current data elements. She presented the current list, which is found in **Attachment 7**.

3.0 Breakout Sessions

3.1 How should the data be collected & stored? (Objective #3)

Participants:

Paul Arbelaez	Carl Hayden
Dave Bauch	Norm Littler
Bob Cameron	Lou Lombardo
Regina Dillard	Andy Mackevicns
Liz Garthe	Sarah McComb
Kathy Gravino	Vernon Roberts
Doug Gurin	Mary Russell

Minutes of Breakout Session:

The group considered how different users affect collection and storage. Wireless uplinks were discussed for ACN application. Hard connections were stated as the methods used to retrieve data from a vehicle. The breakout group also discussed whether these data could be up-linked as part of the crash event data.

The group also discussed evidence and traceability issues related to collection and storage. Manufacturers stated that they needed to know where the data originates.

Currently, manufacturers are collecting and storing data for their own purpose. NHTSA collects data for use in setting public policy and also makes the data public through its public sharing process.

Benefits related to collection and storage were discussed by the group. Engineering, safety, crash reconstruction, data base formation, driver performance, and driver monitoring were discussed as being the most beneficial.

3.2 How should the data be retrieved? (Objective #4)

Participants:

Paul Arbelaez
Dave Bauch
Bob Cameron
Dan D'Angelo
Kathy Gravino
Doug Gurin
Carl Hayden
Norm Littler

Joe Marsh
Sarah McComb
Robert McEloy
Duane Perrin
Vernon Roberts
Mary Russell
Gerald Stewart

Minutes of Breakout Session:

The breakout session discussed issues related to data retrieval from a vehicle EDR. The group first discussed OEM systems, including the GM system available from Vetronix, Corp. It was estimated that the Vetronix system costs about \$2000 to \$2700, and that the user needs power to operate the system. Ford discussed their current engineering tool, which they use to retrieve data from the airbag sensor. This tool is not available to the public. Currently, the configuration of the tool is sensitive to the manufacturer of the airbag sensor, but Ford envisions a common tool for the future.

Truck EDR retrieval systems are being discussed by The Maintenance Council (TMC), part of the American Truck Associations (ATA). They have a recommended practice for interfacing the PCs with the vehicle's engine computer. This EDR system is focused on driver logging, and can be downloaded. Several truck engine manufacturers are currently offering various options, for example, Detroit Diesel can provide driver performance logging for about \$4000. Other truck systems interface with driver logging activities, such as driver smart cards. TMC is looking into standardized downloading capabilities. (See section 4.4 of these minutes for more information.)

The session also discussed certification of data collectors. The group felt training would be beneficial, and noted that Vetronix Corp., was offering training for its CDR. (See section 4.4 of these minutes for more information regarding Vetronix training.) The group also discussed fraud, but did not have any data to report related to this issue.

The breakout session then reviewed a series of issues related to data retrieval. These included:

- a. Power source - may not be any power in vehicle for retrieval.
- crash damage may effect operation of computer data BUS.
- b. Wired EDRs vs. wireless EDR installations.
- c. Reliability.
- d. Size of the data collection equipment.
- e. Information collected in various modules.
- f. Central data source must be robust - submersion, fire, or other disruptive possibilities - must survive that crash.
- g. Protection of the data from fraud.
- h. Access - plug into a central BUS vs. connection to individual EDR (many of these are on the market and all have different interface technology. Also, crash damage may require connection directly to the individual EDR box).
- i. Recording singular events vs. multiple events.

- j. Memory - manufacturers record data for different lengths of time. Memory map could be standardized, additionally, other items could be standardized, including: what is recorded, format for recording, connector for retrieval, download tool for retrieval.
- k. Validity and accuracy of translation - group felt that the technician downloading the data should always provide the "raw" data from the download, for example "hex dump."
- l. Standardization of interface protocol.
- m. Interpretation of data collected related to damage of vehicle.

The group discussed benefits related to retrieval, the use of flight data recorders in the airline industry, and the need for SAE, or someone similar, to be involved to assist in the effort definitions and standards related to retrieval. The group felt that EDRs may become multipurpose.

3.3 Who should be responsible for keeping the permanent record? (Objective #5)

Participants:

Mike Cammisa	John Hinch
Regina Dillard	Ralph Hitchcock
Steve Ezar	Tom Kowalick
Liz Garthe	Lou Lombardo
Martin Hargrave	Andy Mackevicns
Kate Hartman	Douglas Read
Jack Haviland	Susan Walker

Minutes of Breakout Session:

This breakout session discussed who was currently storing EDR data, and possibilities for storing data in the future. NHTSA described its current EDR collection and storage policy. Currently, NHTSA collects EDR data where available in three crash investigation programs: National Automobile Sampling System Crashworthiness Data System (NASS-CDS), Crash Injury and Engineering Network (CIREN), and Special Crash Investigation (SCI). In each of these programs, when a late model GM vehicle equipped with an EDR compatible with the Vetronix CDR tool is identified as being involved in a selected crash, the crash investigation team reads the EDR and makes the output part of the crash record.

The group then discussed if the users effect the storage process. Various users have different needs from EDR data, which may effect the method for storage. Additionally, users have outside restrictions imposed on them, such as the federal government requirement to operate its data collections efforts within the guidelines of existing laws.

The group also discussed collection of EDR data by states. State agencies, such as police and crash investigators, may begin to use EDR data as part of their crash investigation process. If they do, these data may become available at the state level for storage. If the state provides crash data to the federal government, the EDR data may also be included, in which case, the federal

government would maintain these data along with other state reported data. Currently state data are reported using electronic formats, so the EDR data would need to be converted from the paper output, currently generated, to an electronic format compatible with the state files.

The group also discussed electronic collection of EDR data. These data would be transmitted from the crash scene to a central holding facility, after which, using an agreed upon protocol, the data would be transmitted to the state or federal government for storage.

The group then discussed the need for a central repository for EDR data. The federal role is limited, since NHTSA only collects data on crashes related to its internal crash data collection programs. A question was raised as to whether NHTSA would be willing to store data collected by others, such as manufacturers. NHTSA does collect and store data in partnership with manufacturers, and would be willing to discuss a possible role in storing crash data, which include EDR data, for public use.

The group then discussed the non-related subject of crash severity index.

3.4 Demonstration of EDR technology. (Objective #8)

Participants:

Steve Brunson	Tom Kowalick
Mike Cammisa	Joe Marsh
Dan D'Angelo	Robert McElroy
Martin Hargrave	Douglas Read
Jack Haviland	Gerald Stewart
John Hinch	Paul Tremont
Ralph Hitchcock	Susan Walker

Minutes of Breakout Session:

This breakout session generated a list of possible EDR demonstration sources, including:

- a. OEM (light vehicles, buses, and heavy trucks)
- b. NHTSA (SCI, CIREN, and/or NASS-CDS)
- c. NTSB (surface transportation if possible)
- d. Race Car
- e. VDO (use of systems in crash investigation)
- f. ATA's TMC
- g. Military
- h. Vetronix
- i. TRB
- j. Litigation
- k. Forensic Accident (success story)

The following topic areas should be considered when documenting an EDR demonstration: application, benefits, use, real-time needs vs. research needs, data elements, and what was collected. The demonstration should present a good success story for EDR, if possible.

The group then noted important areas related to EDR demonstration. The following were noted by the members:

- a. Use of ACN.
- b. Acquisition of useful crashworthiness data (such as delta-v).
- c. Acquisition of data to assist the investigator in determining the cause of the crash.
- d. Show positive side, not just negative side, such as a driver monitor.
- e. Use as a research tool to define occupant restraint effectiveness.
- f. Location of a crash.
- g. Roadside benefits - Crash data that could be used to develop new roadside safety features.
- h. Use of EDR data that provides direct benefit to the vehicle owner.
- i. Validation efforts to show that EDRs produce reliable accurate data.
- j. General discussion of differences that exist in current systems.

3.5 Breakout Session Summaries

Breakout sessions gave a short summary of their respective sessions activities.

4.0 Working Group Activities

4.1 Next Meeting

The WG discussed generation of the final report. The following dates were agreed upon for final report action:

End of June 2000	EDR WG members sign-up for writing report sections
Mid July	Distribution of writing assignments
Mid September 2000	Draft of sections due to NHTSA
End of October 2000	Distribute draft to WG members
Dec 6, 2000	Meet in Washington to review draft report

4.2 Press Clips

Robert Cameron presented the working group with a copy of several articles he had located since the past meeting. They are found in **Attachment 8**.

4.3 Final Report

John Hinch circulated a draft final report outline for the WG members to review. A copy is found in **Attachment 9**.

4.4 Other Material (Copies of these materials are found in Attachment 10.)

- The American Trucking Associations, Inc., through The Maintenance Council (TMC), has developed a draft recommendation practice for "PC to User Interface Recommendations for Electronic Engines." This practice sets forth methods for truck technicians to communicate with electronic engine controls often installed on large heavy truck engines. This practice is applicable to our objective #4 - How should the data be retrieved?

- A copy of a document “Crash Survivable Module for Trucks and Buses,” was submitted by Smiths Industries, of Grand Rapids, Michigan. This company manufactures crash data recorders for the aerospace industry, and has recently written a specification document on crash survivability needs for similar recorders, when installed on highway vehicles, particularly trucks and buses. Contact Barry Casey at Smiths Industries - (616) 241-7582 for further information.
- Tom Kowalick discussed his Type I - Type II concept for classifying EDRs. Type I EDRs would record a minimum set of crash related data - including: time, date, direction, velocity, occupants, and seat belt usage. The Type II EDRs would record these data, plus many others, which are described in his handout.
- The Vetronix Corporation is offering a training course for the use of their recently released CDR tool. This tool allows the user to read EDRs installed on some late-model GM vehicles. Contact James Kerr at Vetronix - (800) 321-4889, extension 3238 for more information.

Attachments

1. Agenda
2. Attendance List
3. Georgia Tech Slides
4. LMS and Florida Atlantic University Slides
5. Legal Framework
6. Ford Slides
7. Data Element Chart
8. Press Clips
9. Draft Final Report Outline
10. TMC Draft Recommended Practice
 - Smiths Industries paper
 - Tom Kowalick's Type I-Type II Classification Proposal
 - Vetronix Corporation CDR Training

AGENDA

Event Data Recorder Meeting #6

9:30 a.m. - 4:00 p.m. Wednesday, June 7, 2000

Room 6200-04 NASSIF Building; 400 7th Street S.W.; Washington DC 20590

Working Group Objective

Facilitate the collection & utilization of collision avoidance and crashworthiness data from on-board EDRs.

Meeting Objectives:

Breakout sessions:

How should the data be collected & stored? (Objective #3)

How should the data be retrieved? (Objective #4)

Who should be responsible for keeping the permanent record? (Objective #5)

Demonstration of EDR technology. (Objective #8)

Morning

9:30 Welcome and Introductions
John Hinch

9:40 Review and Approval of Feb, 2000, Meeting
Minutes (John Hinch) [Review Corrections]

9:45 Report Crash Data Collection using EDR
Technology (Jennifer Ogle/John Mackey)

10:00 Report from Ford and NHTSA SCI on
Advanced Restraint Program using EDRs
(Joe Marsh/Chip Chidester)

10:15 Report on Manufacturer Data Element
Discussions (Kathy Gravino)

10:30 Breakout Sessions
**Objective #8: Demonstration of EDR
technology.**

**Objective #3: How should the data be
collected & stored?**

Session Discussion Instructions

- Names of participants
- Nominate facilitator
- Take session notes for meeting record
- Develop summary

12:00 Lunch

Afternoon

1:00 Breakout Sessions

**Objective #5: Who should be responsible
for keeping the permanent record?**

**Objective #4: How should the data be
retrieved?**

2:30 Breakout sessions summaries (10 min each)

3:15 -4:00 Working Group Business

- EDR Resource Center
- Truck & Bus EDR Working Group
- Working Group Final Report
 - Group discussion
 - Writing assignments
 - Draft review process
- Next Meeting
 - Date (possibly Oct 3, 2000)
 - Review draft of Final Report

EDR MEETING # 6; June 7, 2000; Washington DC

Name	Company	E-Mail	Phone	Fax
Kathy Gravino	DaimlerChrysler	kg15 kg15@daimlerchrysler.com	248-576-3613	248-576-7918
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Bauch

DBauch

EDR MEETING # 6; June 7, 2000; Washington DC

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	jmarsh@Ford.Com	313 390 2171	313 594 0723

OBJECTIVE

Investigate and provide an understanding of the relationship between driver speed and crash risk under various demographic, environmental, and physical conditions.



THE 100-MPH CLUB

PEDAL TO THE METAL



Number of drivers hitting highest speeds is up sharply

1000
TICKETS
WRITTEN
EACH YEAR
FOR
SPEEDING
OVER
100 MPH
IN ATLANTA

9 Crash Statistics - Atlanta

County	Crashes	Licensed Drivers	Crash Probability
Fulton	49,007	546,980	0.09
Dekalb	31,008	430,071	0.07
Cobb	26,001	428,747	0.06
Gwinnett	21,113	381,530	0.06
Cherokee	3,428	94,183	0.04
Forsyth	2,763	51,989	0.05
Paulding	1,371	42,958	0.03
Douglas	3,525	65,599	0.05
Fayette	2,596	65,038	0.04
Rockdale	2,768	50,388	0.05
Clayton	10,407	149,653	0.07
Henry	3,371	70,965	0.05
Coweta	2,333	56,807	0.04
13-County Total	159,691	2,434,908	0.07

We need to know...

- Driving Characteristics Data
 - route information
 - instantaneous speed, acceleration
 - sub-second 3-axis acceleration data (crashes and near-misses)
- Driver demographics, socio-economics
 - What groups of drivers are more likely to speed and/or be involved in near-misses or crashes?

- **Attitudes/stress/heuristics data**

- Are there specific attitudes re: safety or driving shared in common to risk-takers/crash involved?
- What is the stress load of risk-takers/crash involved?
- What safety heuristics are used by risk-takers/crash involved

- **Specific Crash Data**

- What driver maneuvers are related to crashes involving speed?
- Under which driving conditions does exceeding the speed limit most likely to lead to a crash?



- **Prevailing Traffic Conditions**

- What is the nature of the association between travel speed at the time of the crash and typical prevailing speed at the crash site?

- **Environmental conditions**

- Under what environmental conditions to drivers speed (i.e. weather: ice, fog, rain; daylight/darkness)?
- What types of facilities do drivers usually speed on?
- What traffic conditions do drivers speed in?



What do these data look like?

...an excerpt from the
NHTSA Pilot Study
(which this study is based on)



Field Test Data

- Downloaded data once a week via cell phone and modem
- Data logging rates varied between 1 sec, 3 sec, and 5 sec

	1-second	3-second	5-second
Collection period (wks)	4	3	10
Total records in data set	1,493,543	636,721	2,255,245
Number of filtered records	684,487	281,897	919,567
Number of remaining in evaluation data set	809,056	345,734	1,335,678

Total Evaluation Records = 2,490,468

Total Observed Trips = 20,818



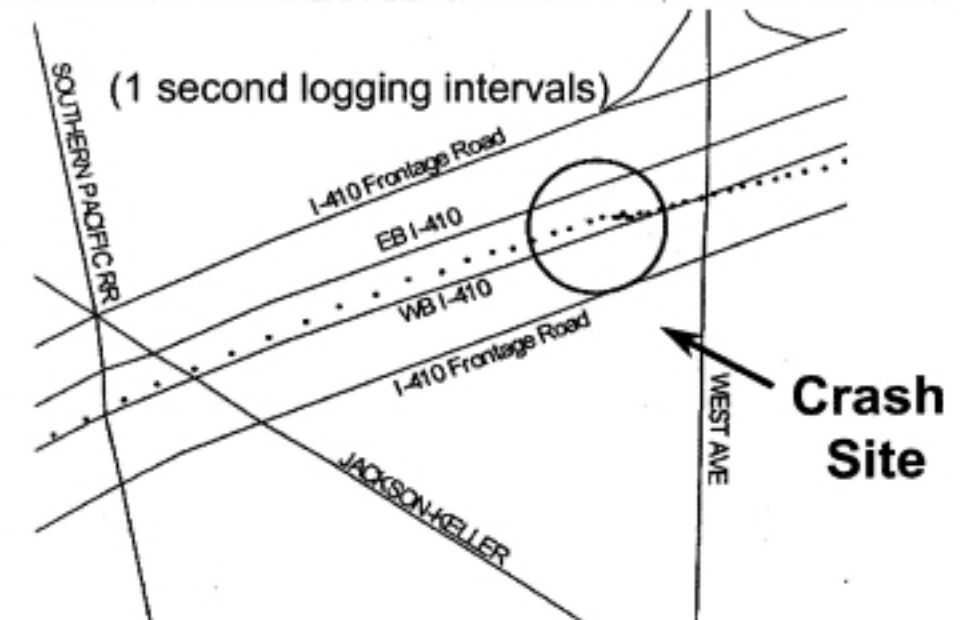
Details of Observed Crash

and accident
 o struck
 rger car (shown)
 d freeway
 s each direction
 M, Mon., 6/8/98
 sted Conditions



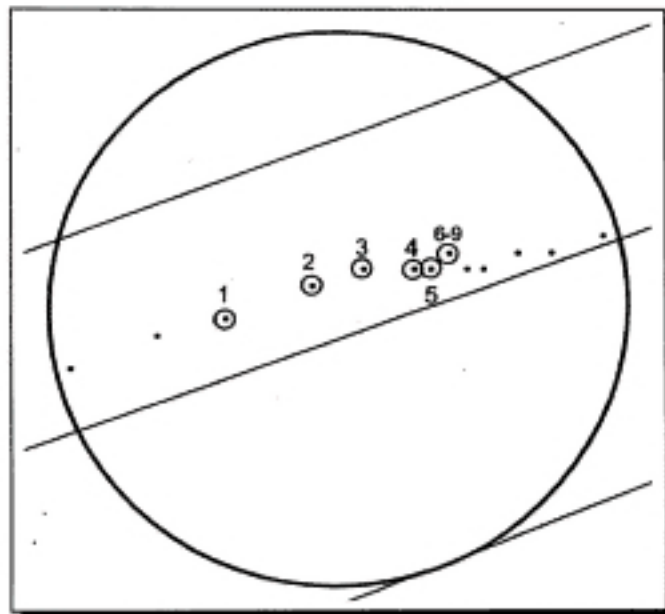
Georgia
 Tech

Macroscopic View of Crash Data



Georgia
 Tech

Microscopic View of Crash Data



Point #	Time (GMT)	Speed (mph)
1	22:24:46	21.5
2	22:24:47	19.7
3	22:24:48	14.2
4	22:24:49	7.9
5	22:24:50	7.3
6	22:24:51	1.5
7	22:24:52	0.0
8	22:24:53	0.0
9	22:24:54	0.0

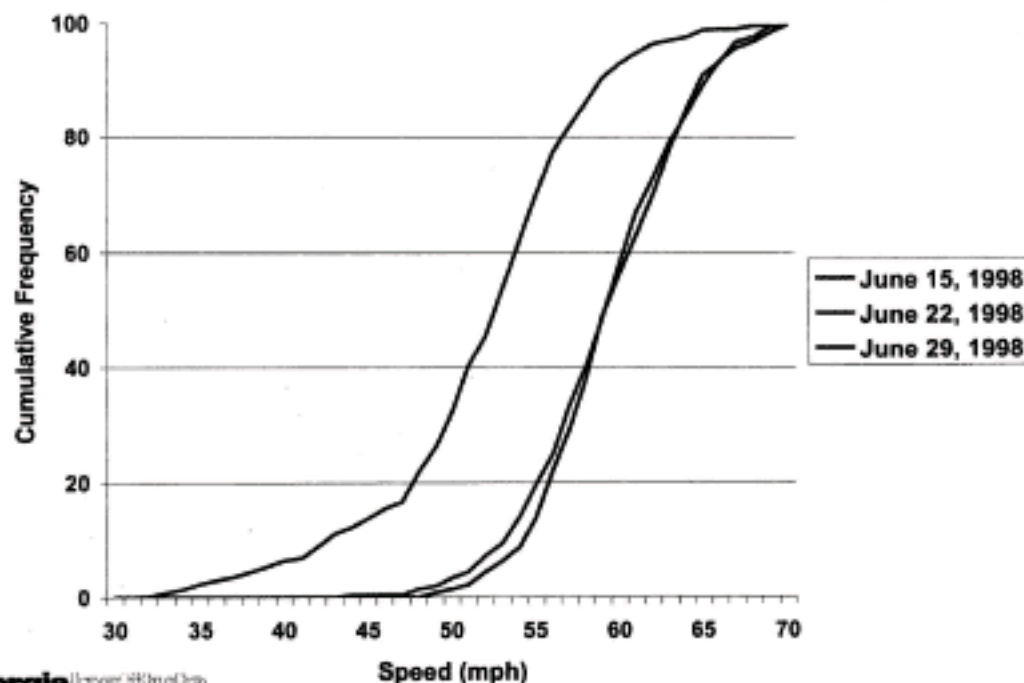
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Prior Data from Area of Crash

Unit ID	Trip #	Date	Time (GMT)	Latitude	Longitude	Speed (mph)
D6040633	10	31/3/98	22:44:42	29.51658	-98.5274	63.4
D6040633	10	31/3/98	22:44:47	29.51707	-98.5262	68.6
D6040633	22	2/4/98	20:08:49	29.51663	-98.5275	28.5
D6040633	22	2/4/98	20:08:54	29.51688	-98.5269	33.8
D6040633	22	2/4/98	20:09:59	29.51712	-98.5263	31.3
D6040633	40	3/4/98	21:29:39	29.51642	-98.5278	17.7
D6040633	40	3/4/98	21:29:44	29.51660	-98.5274	27.1
D6040633	40	3/4/98	21:29:49	29.51677	-98.5269	19.8
D6040633	40	3/4/98	21:29:54	29.51688	-98.5267	9.0
D6040633	40	3/4/98	21:30:59	29.51695	-98.5265	14.2
D6040633	40	3/4/98	21:30:04	29.51707	-98.5262	17.3

Georgia
 Tech

Crash Site Speed Distributions



WHAT'S NEXT???

Georgia Tech's Scope of Work (Full-Scale Study)

METHOD

• COLLECT DATA

- Driver Demographics – Obtain personal information through individual travel survey forms and travel diari administered through the SMARTRAQ project.
- Driving Characteristics Data – Instrument subjects ve with equipment to record speed and position for each Records will then be matched with GIS to determine relationships of driver speed vs. speed limit, facility ty etc.
- Specific Crash Data – Instrumented vehicles will also capability of detecting accidents and communicating details to researchers and emergency personnel thro onboard cellular connection. The research team will immediately survey the crash site and collect pertine information.

METHOD (cont.)

- Prevailing Traffic Conditions – Once a crash is detected, research teams will be sent to each crash site to collect speed distributions for prevailing traffic. Data will be collected at the same time and day of week of crash during 3 consecutive weeks following the crash. This data will be used to determine recurring/non-recurring speed/traffic patterns. Manually collected data as well as archived ATMS data will be utilized.
- Attitudinal/mental state/heuristic data from periodic surveys conducted throughout study period
- COMPILE DATA
- ANALYZE DATA

SCOPE

- *1000 Vehicles in Atlanta for 2 years equipped with monitoring and crash detection equipment*
- *Georgia Tech – project management, oversight of systems integration, data collection, analysis*
- *Veridian Engineering – systems integrator*
- *BellSouth – supplier of cellular analog service*



TIMELINE

- Equipment acceptance testing by August 2000
- Infrastructure set-up and testing by October 2000
- Installation and data collection begins November 2000 (staggered)
- Field test for 2 years



SUBJECT SELECTION

Subjects will be selected in conjunction with the Year 2000 SMARTRAQ Travel Survey recruitment.

SMARTRAQ - Strategies for Metropolitan Atlanta's Regional Transportation and Air Quality

SMARTRAQ is based on the integration of multiple data collection efforts surrounding an 8,000 household travel survey to address land use, travel behavior, air quality, safety as well as other critical issues in the Atlanta area.



SMARTRAQ Sample

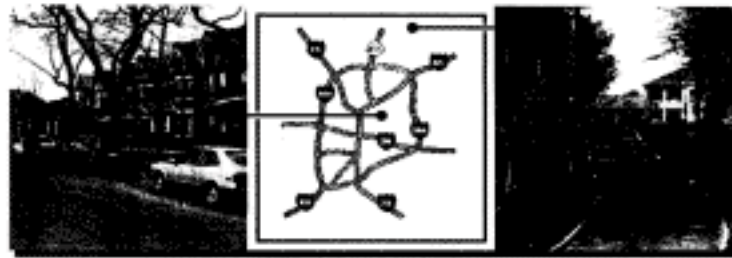
Random Sample of Households based on:

- Income (4-5 strata)
- Household Size (4-5 strata)
- Land Use – Residential Density (4-5 strata)

Will keep vital statistics: refusals, sample characteristics, response rate, etc.

- Will equip up to two vehicles per household
- Household vehicles will be stratified to ensure varying age groups across the drivers

and Use and Exposure



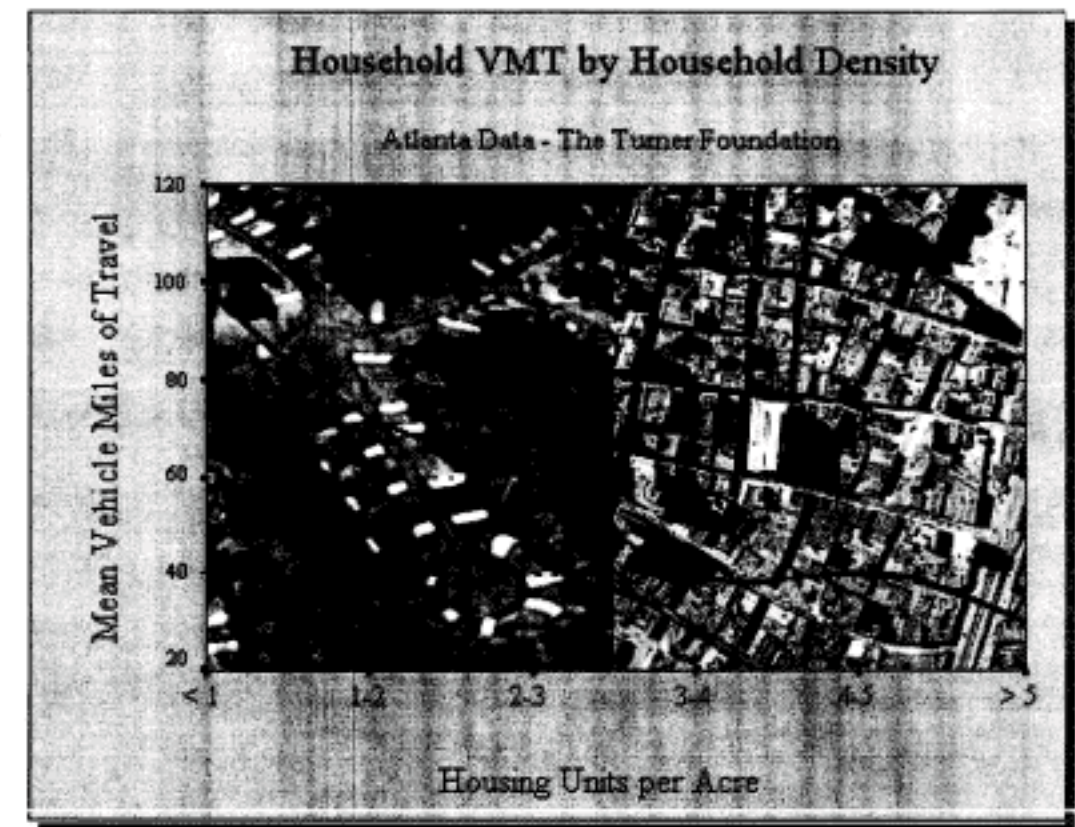
Profile of Family A (Urban)

8 units per acre
parking is limited
services nearby
family of four
annual income \$50,000
one vehicle
four vehicle trips/day
46 miles of travel

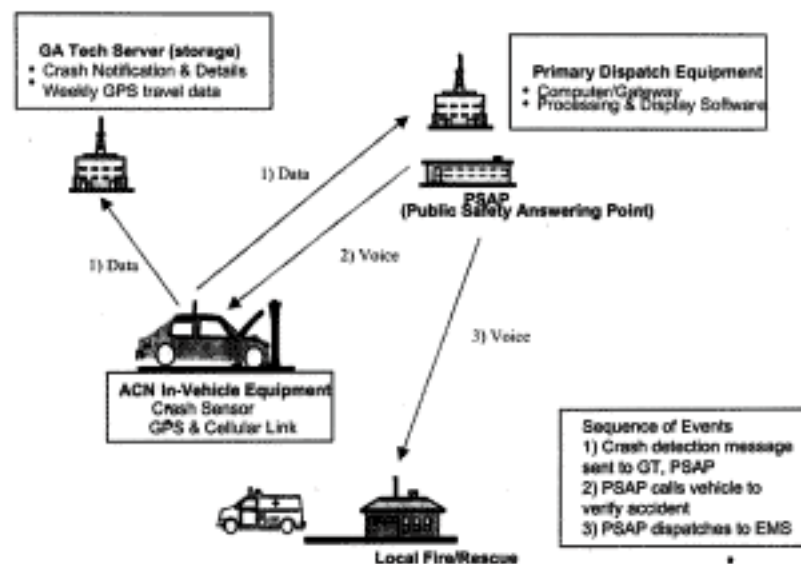
Density
Parking
Mixed Use
Household Size
Income
Vehicles
Trips
Miles of Travel

Profile of Family B (Ex-urban)

1 unit per acre
parking on site
no services within walking distance
family of six
annual income \$90,000
three vehicles
eleven vehicle trips/day
101 miles of travel



Data Flow Diagram



Equipment

- In-vehicle system
 - Veridian Crash Detection Module (512 kb)
 - Trimble CrossCheck Telematics Platform (1200 baud, 250 kb) with Trimble 8-channel GPS receiver
 - CSI stand-alone DGPS receiver
 - cellular antenna, GPS antenna, DGPS antenna
- PSAP ACN system
- GA Tech central and backup servers, workstation
- Possible servers at ATMS and Trauma Centers (not funded)

Data Requirements

1) Driving Characteristics Data (every trip)

- high resolution
(GPS data at 1 to 5 second frequencies)
- low resolution
(GPS data aggregated to trip level information for every trip)

2) Near Miss / Aggressive Driving Characteristics

- thresholds to be determined using Veridian data sets

3) Accident Detection and Notification

- similar functionality as existing Veridian ACN System



Driving Characteristics Data

Driving Characteristics Data -- high resolution (GPS data at 1 to 5 second frequencies)

Parameter	Format
Date	YYMMYY
Time	HHMMSS
Latitude	decimal degrees xx.xxxxxx
Longitude	decimal degrees xx.xxxxxx
Speed	miles per hour xxx.x
Acceleration	forward motion only, mph/sec xx.x
Heading	Degrees from true north xxx.x
DGPS status	0=no GPS signal, 1=GPS only, 2=DGPS
# Satellites	Number of satellites used in position calc
HDOP	Horizontal Dilution of Precision



Driving Characteristics Data

Driving Characteristics Data -- low resolution (trip level)

Start Record:

Date, Time, Coordinates

Finish Record:

Date, Time, Coordinates, Vehicle Miles Traveled



Data Transfer Activities

- Driving characteristics including speeds/accelerations/near misses data
- transfer periodically (e.g., when storage reaches threshold or bi-weekly) in off-peak hours
- Accident Notification message sent immediately upon detection
- Scheduled system integrity checks will verify that all units are communicating properly



Data Transfer Capabilities

- Bell South Mobility:
 - monthly transfer allowance: 120 minutes / unit
- Trimble CrossCheck Telematics Platform:
 - 1200 baud (~ 1200 bits / second)
- Average 2 hours / day of travel
 - 86 kb / day at 1 second frequency
 - 17 kb / day at 5 second frequency
 - < 1 kb /day at trip-level frequency

Data Transfer Budget Plan

- Design system to be remotely configurable
 - each unit can be set at 1 second, 5 second, or trip level frequencies throughout the study period
- First assess actual unit throughput and amount of travel per participant
- Then maximize data collection within monthly pooled minutes constraint

Data Accuracy

- RFP called for high levels of accuracy:
 - correct roadway identification: 95% of time
 - correct segment identified within 10 feet: 90% of time
 - speed accuracy within +/- 2% of actual speed
- Selective Availability: Intentional degradation of signal accuracy by U.S. DoD
- Levels of Accuracy Available at Proposal
 - • GPS with Selective Availability: 30 - 100 meters
 - GPS with Differential Correction: 3-5 meters

Data Accuracy

- May 1, 2000 President Clinton announced the immediate termination of Selective Availability
- Levels of Accuracy Available
 - • GPS with Selective Availability: 30 - 100 meters
 - • GPS w/o Selective Availability: 10 - 20 meters
 - • GPS with Differential Correction: 3-5 meters
- Possibility to save costs if GPS w/o SA proves to meet project accuracy requirements (TBD)

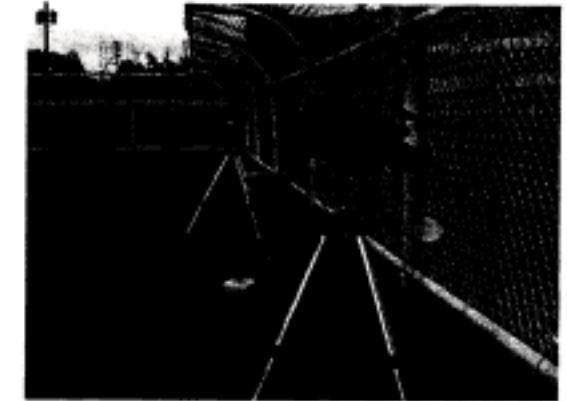
CRASH SITE WORK

- *Crash Investigations:*
 - 2-person team sent immediately to each crash site to collect detailed crash reconstruction data, vehicle/site pictures, etc.
- *Speed Distributions:*
 - 3-person team sent to each crash site to collect speed distributions for prevailing traffic at the same time and day of week of crash during the 3 consecutive weeks following the crash (used to determine abnormal speed/traffic patterns as they may be associated with the crash)
 - ATMS system will be used wherever available

Crash Site Speed Distributions



Laser Rangefinder Data Recording System



High Resolution Video Monitoring System

GIS Detail



ANALYSIS PLAN

- ✓ Propose theoretical models regarding driver risk and risk-outcomes
- ✓ Design an experiment to collect data that enables the testing of the theoretical models
- ✓ Estimate statistical models to validate (or invalidate) to theoretical models
- ✓ Document findings of statistical models

Motivation for Theoretical Model Development:

- ✓ What are the "high-risk" behaviors that lead to crash (and crash-related) outcomes?
- ✓ What socio-demographic factors are associated with "high-" and "low-risk" drivers?
- ✓ What attitudinal and/or heuristic factors are associated with "high-" and "low-risk" drivers?
- ✓ What is the nature of the relationship between "local" conditions and crash risk and severity?

Theoretical Model 1:

What are the "high-risk" behaviors that lead to crash (and crash-related) outcomes?

$$\Pr(\text{Crash}) = f(X_1\beta_1 + X_2\beta_2 + \dots + X_p\beta_p)$$

- X_1 = speeding behavior variables
(e.g. proportion of driving time by functional class; mean speed difference by functional class)
- X_2 = aggressiveness behavior variables
(e.g. proportion of driving time in high-power driving conditions; # of high-power driving conditions/mile)
- X_3 = unsafe for conditions variables
(e.g. mean speed difference at night; mean speed difference during wet pavement days)

Theoretical Model 2:

What are the socio-demographic and attitudinal/heuristic factors associated with "high-" and "low-risk" drivers?

$$Freq_{speed} = f(X_1\beta_1 + X_2\beta_2 + \dots + X_p\beta_p)$$

$$Freq_{aggres.} = f(X_1\beta_1 + X_2\beta_2 + \dots + X_p\beta_p)$$

- | | |
|--------------------------------|---|
| X_1 = age | X_6 = occupational risk |
| X_2 = gender | X_7 = risk adversity |
| X_3 = driver history | X_8 = safety rules of thumb |
| X_4 = driver experience | X_9 = life cycle stage (responsibility) |
| X_5 = functional class usage | |

Theoretical Model 3:

What is the nature of the relationship between "local" conditions and crash risk and severity?

$$Severity_{Crash} = f(X_1\beta_1 + X_2\beta_2 + \dots + X_p\beta_p)$$

X_1 = speed of vehicle

X_2 = functional class

X_3 = speed relation to prevailing conditions

X_4 = vehicle type

X_5 = primary object impacted

X_6 = roadside hazard rating



Data Stream Information

- ✓ Driver identification (crash report)
- ✓ Attitudinal/heuristic survey of participants (risk adversity, job risk, etc.)
- ✓ Second-by-second data of driving (speed, aggressiveness)
- ✓ GPS to identify position and facility functional class
- ✓ Speed and environment monitoring on selected corridors (speed differential, wet pavement conditions)
- ✓ Driver histories (permission from participants)
- ✓ Physical performance assessments (perception and reaction times, vision, hearing)



Analysis Methods

- ✓ **Poisson & Negative Binomial Regression Models**
crash frequency, speeding frequency
- ✓ **Parametric and Semi-Parametric Survival and Hazard Models**
time-until-event (crash, near-miss, ticket, censoring)
- ✓ **Multinomial (ordered) Choice Models**
crash severity
- ✓ **Structural Equation (latent variable) Models**
Crash risk and attitudes and physical performance



Outcomes of Interest

- ✓ **Crash occurrence and frequency**
 - Obtain through monitoring program
- ✓ **Crash severity**
 - PDO, injury scale (4 to 7 point scales)
- ✓ **Aggressive driving (e.g. speeding, high accels)**
 - Speeds relative to posted speed limits at selected locations on driver's routes
 - Speeds relative to prevailing speeds (obtained through GT video feed of major corridors)
- ✓ **Near-miss events**
 - Obtained through video and development of "near miss" acceleration envelope



Covariates of Interest

- ✓ traffic exposure
 - VMT, VHT, prevailing conditions
- ✓ facility exposure
 - facility class
- ✓ environmental factors
 - rain, ice, fog, etc.
- ✓ driving behavior
 - aggressiveness, speeding
- ✓ travel behavior
 - trip purpose
- ✓ socio-demographic factors
 - age, gender, job risk, etc
- ✓ driving history
 - tickets, crashes
- ✓ physical performance
 - vision, perception times, reaction times
- ✓ attitudes
 - measure risk-adversity



BUDGET

- Contributors
 - NHTSA \$1,900,000
 - Georgia Tech \$275,000
 - LMS \$400,000
- **TOTAL \$2,575,000**

